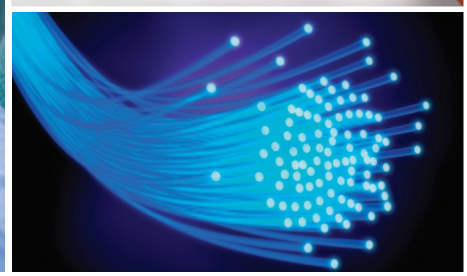
technology opportunity

Real-Time 3D Shape Rendering

Ultra-fast algorithms enable smart structures with unparalleled self-monitoring capabilities



Researchers at NASA's Dryden Flight Research Center have developed an innovative method for rendering the bending shape of an optical fiber cable in real time. Unlike current methods used to calculate shape rendering, which are complex and time-intensive and which may have lag time, this technology's streamlined algorithms require no post-processing. Dryden's system scans at a rate of 100 times per second, providing instantaneous three-dimensional (3D) shape rendering. The adaptive algorithm can discriminate between areas with high vs. low strain activity. This feature provides fewer data points on slowly changing portions of the structure and more data on portions of the structure under greater change. In the field of aeronautics and civil engineering, this significant advancement enables smart structures that can be equipped with lightweight fiber optics to perform self-monitoring of strain levels and movement. It also can be used for medical procedures, oil and gas drilling, and more.

Benefits

- **Real-time shape rendering:** Dryden's method of processing data from fiber optic sensors is much faster than other methods, allowing real-time visualization of 3D shape.
- **No lag time:** Unlike existing shape rendering methods, no post-processing is required.
- **Lightweight:** This technology can be used without adding significant weight or size to a structure, which is particularly important.

Applications

- **Medical:** Procedures involving endoscopes, catheters, or robotic surgery
- **Oil and gas:** Sophisticated industrial borescope usage in drilling and exploration
- **Aeronautics:** Structural monitoring for complex bending modes of in-flight aircraft
- **Renewable energy:** Structural monitoring for wind energy turbines
- **Robotics:** Precise position monitoring and control of robotic arms and tools
- **Automotive:** Structural monitoring
- **Nautical:** Pinpoint location of buoys or instrument packages

Technology Details

This technology measures differential strain through a unique computational method, offering real-time 3D shape rendering. Embedding sensors into the optical fiber and then attaching the fiber to a structure allows strain information to be collected and shape deformation determined. Once the strain data is correlated into displacement data, the shape and movement of the optical fiber, and therefore the attached structure, can be displayed in real time.

How It Works

To obtain the curvature and torsion, innovators embedded three optical fibers with sensors either with fiber Bragg gratings (FBGs) or other methods of obtaining strain through optical fiber. The strain of each fiber is measured through Dryden's patent-pending strain algorithm and fiber optic strain sensor (FOSS) hardware, which interrogates the fiber at a rate of 100 samples per second. Dryden innovators have also patented a method to mitigate signal loss due to polarization-induced fading (PIF), a common problem seen in multi-sensor fiber optic sensing systems. This ensures that signals from all sensors can be optimally retrieved, increasing the system's accuracy and reliability.

Why It Is Better

The most significant benefit of Dryden's 3D shape rendering technology is its unparalleled speed. Its sophisticated algorithms enable real-time shape rendering without any lag time whatsoever. Furthermore, the preferred implementation of this technology relies on a continuous FBG and adaptive spatial resolution capability that allows broad flexibility in how many sensors can be used on a single fiber. As a result, measurement resolution can be as fine or as coarse as necessary. The adaptive algorithm adjusts the spatial resolution of the fiber in response to strain activity. As the fiber experiences variations of strain, the algorithm can increase the spatial resolution in areas with heavy strain activity. Likewise, fewer data points can be provided in areas where little strain activity is occurring. This is extremely helpful during post-test analysis when researchers and engineers need to identify critical information quickly.

Fiber wrapped around object is rendered in real-time

Patents

Dryden has a patent pending for this technology.

Licensing and Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Office, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing the In-Situ Three-Dimensional Shape Rendering from Strain Values Obtained through Optical Fiber Sensors (DRC-011-015) as well as other elements of the fiber optic sensing portfolio.

For more information about this technology, please contact:

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